

CLAIMS

1. A variable geometry turbocharger comprising:
 - a turbine wheel mounted within a turbine housing on one end of a turbocharger shaft for rotation about a turbocharger axis, the turbine housing defining an annular turbine inlet around the turbine wheel;
 - a compressor wheel mounted within a compressor housing on the other end of said turbocharger shaft for rotation with the turbine wheel about said axis;
 - turbocharger shaft bearing assemblies located within a bearing housing connected between the turbine housing and the compressor housing;
 - a variable geometry mechanism for varying the size of the annular turbine inlet; and
 - an electric motor for actuating the variable geometry mechanism;
 - wherein the electric motor is a tubular linear electric motor comprising a fixed annular stator ring and an axially moveable annular forcer ring, arranged coaxially about said turbocharger axis with movement of the forcer ring effecting adjustment of the variable geometry mechanism.
2. A turbocharger according to claim 1, wherein the electric motor is located within the bearing housing.
3. A turbocharger according to claim 2, wherein the bearing housing comprises an inner annular wall surrounding said turbocharger shaft and said bearing assemblies, and an outer annular wall surrounding said inner annular wall, wherein the electric motor is located within an annular space defined between the inner and outer annular bearing housing walls.
4. A turbocharger according to claim 1, wherein the stator ring comprises a conductive coil energisation of which generates a magnetic field which interacts with the forcer ring thereby exerting an axial force on the forcer ring.

5. A turbocharger according to claim 1, wherein the forcer ring comprises a conductive coil energisation of which generates a magnetic field which interacts with the stator ring thereby exerting an axial force on the forcer ring.

6. A turbocharger according to claim 4, wherein the electric motor is a reluctance motor, said forcer ring comprising a reluctance magnet.

7. A turbocharger according to claim 5, wherein the electric motor is a reluctance motor, said stator ring comprising a reluctance magnet.

8. A turbocharger according to claim 6, wherein the stator ring and forcer ring each comprises one or more radially extending portions, the radially extending portions of the stator ring extending in a radial direction towards the radially extending portions of the forcer ring and vice versa, the reluctance force generated by energisation of said coil tending to bring radially extending portions of the stator ring and forcer ring into alignment with one another.

9. A turbocharger according to claim 7, wherein the stator ring and forcer ring each comprises one or more radially extending portions, the radially extending portions of the stator ring extending in a radial direction towards the radially extending portions of the forcer ring and vice versa, the reluctance force generated by energisation of said coil tending to bring radially extending portions of the stator ring and forcer ring into alignment with one another.

10. A turbocharger according to claim 8, wherein said radially extending portions are annular.

11. A turbocharger according to claim 9, wherein said radially extending portions are annular.

12. A turbocharger according to claim 7, wherein the coil is located between radially extending portions of the stator ring or forcer ring.
13. A turbocharger according to claim 7, wherein the stator ring and forcer ring are each generally "c" shaped in axially cross-section, each having two radially extending annular portions.
14. A turbocharger according to claim 5, wherein the electric motor is a brushless AC motor wherein the forcer ring is a permanent magnet, said force being produced by the Lorentz effect.
15. A turbocharger according to claim 6, wherein the electric motor is a brushless AC motor, the stator ring comprising a permanent magnet such that the force is produced by the Lorentz effect.
16. A turbocharger according to claim 1, wherein the stator ring surrounds the forcer ring.
17. A turbocharger according to claim 1, wherein the forcer ring surrounds the stator ring.
18. A turbocharger according to claim 1, wherein the stator ring is defined at least in part by a portion of the housing.
19. A turbocharger according to claim 1, wherein the forcer ring slides on a linear bearing which lines the inner surface of the outer bearing housing wall or the outer surface of the inner bearing housing wall.

20. A turbocharger according to claim 1, wherein a plurality of push rods extend from the forcer ring to the variable geometry mechanism.
21. A turbocharger according to claim 20, wherein said push rods extend through respective bores in an annular housing wall separating said annular space in which the electric motor is located from the variable geometry mechanism.
22. A turbocharger according to claim 1, wherein the variable geometry mechanism comprises an axially movable annular member, an annular portion of which defines one wall of said annular turbine inlet.
23. A turbocharger according to claim 1, wherein the bearing housing is fabricated from a ferromagnetic metal such as iron or an iron based alloy.